DOE Light Water Reactor Sustainability Program

Uses of Advanced Sensors and Instrumentation to Improve Performance in Existing Nuclear Power Plants

FY 2012 Nuclear Reactor Technologies Summit

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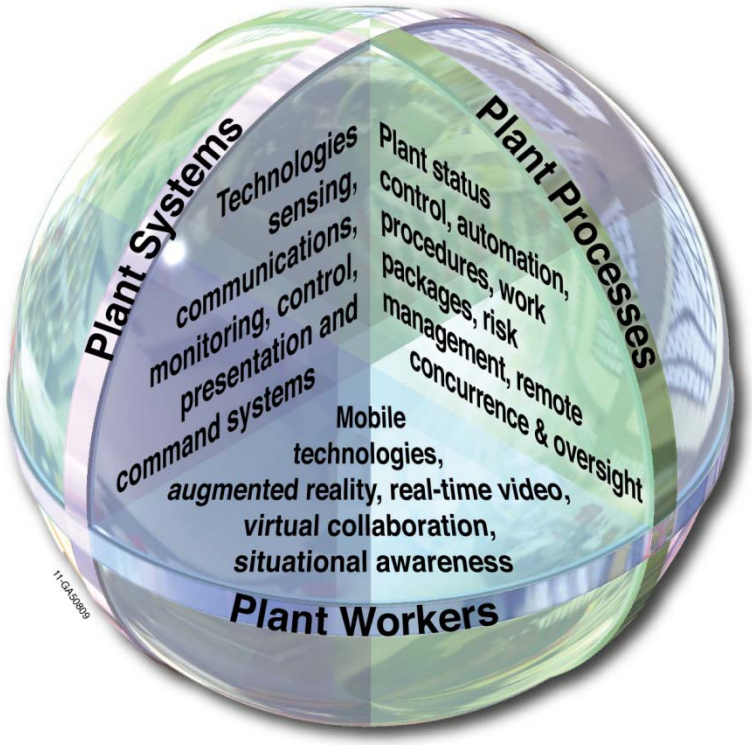
Advanced Instrumentation, Information, and Control (II&C) Systems Technologies

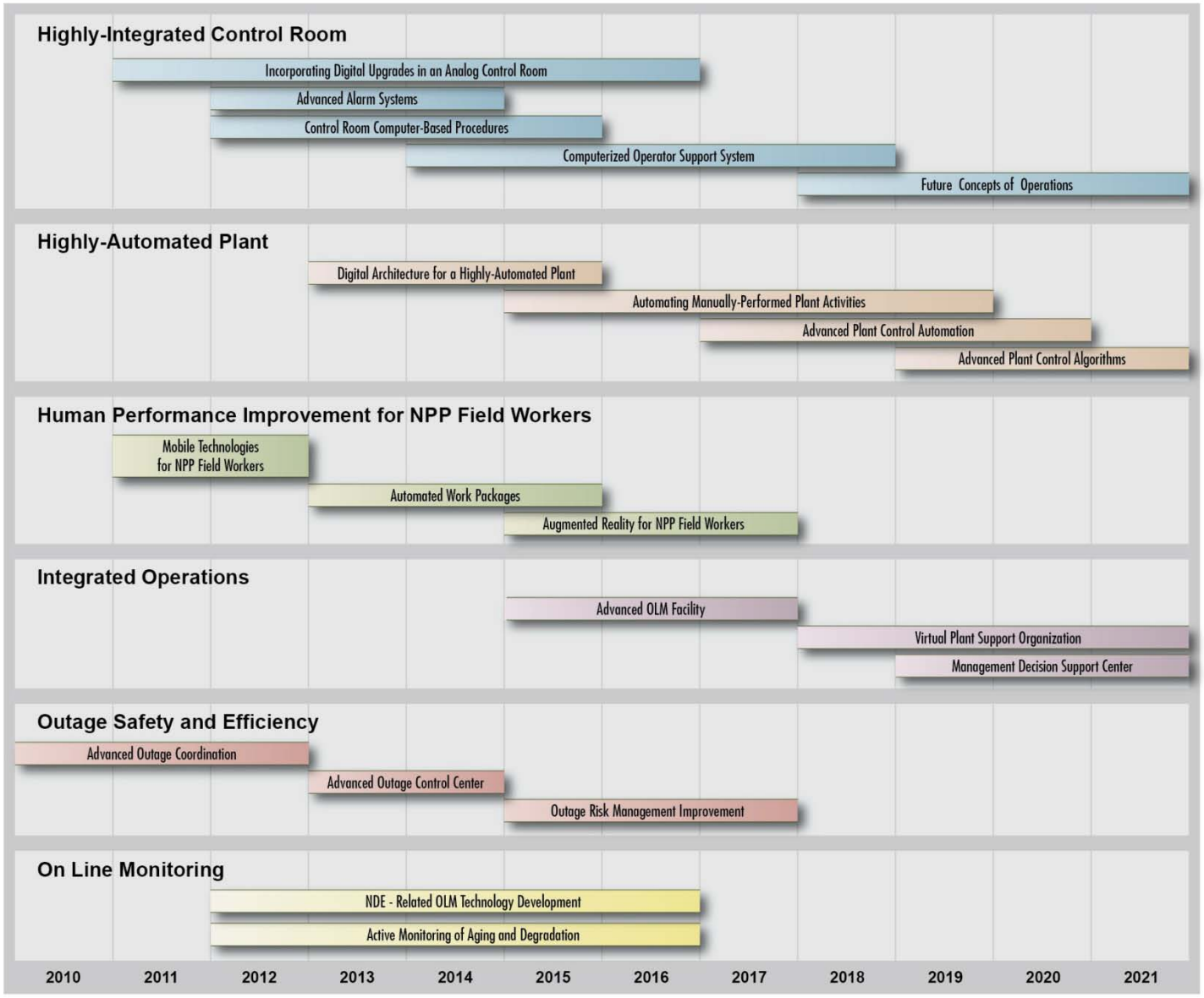
- *Address long-term aging and reliability concerns of existing II&C technologies and develop and test new technologies*
- *Establish a strategy to implement long-term modernization of II&C systems.*
- *Develop advanced condition monitoring technologies for reliable plant operation and develop the means to detect and characterize aging degradation processes.*

Long-Term II&C Modernization Strategy

To significantly reduce the technical, financial, and regulatory risk of II&C modernization by:

- demonstrating and validating new technologies and operational concepts at host nuclear plants, addressing legacy II&C technology challenges and future business innovation.
- transforming the operating model, integrating plant systems, plant processes, and plant workers.
- providing guidance for full-scale implementation.
- providing Technical Basis Reports to support utility II&C long-term planning, regulatory submittals, and procurement.
- communicating the work of this program to nuclear power stakeholders.




Highly-Integrated Control Room
Incorporating Digital Upgrades in an Analog Control Room
Advanced Alarm Systems
Control Room Computer-Based Procedures
Computerized Operator Support System
Future Concepts of Operations
Highly-Automated Plant
Digital Architecture for a Highly-Automated Plant
Automating Manually-Performed Plant Activities
Advanced Plant Control Automation
Advanced Plant Control Algorithms
Human Performance Improvement for NPP Field Workers
Mobile Technologies for NPP Field Workers
Automated Work Packages
Augmented Reality for NPP Field Workers
Integrated Operations
Advanced OLM Facility
Virtual Plant Support Organization
Management Decision Support Center
Outage Safety and Efficiency
Advanced Outage Coordination
Advanced Outage Control Center
Outage Risk Management Improvement
On Line Monitoring
NDE - Related OLM Technology Development
Active Monitoring of Aging and Degradation
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
11-50008

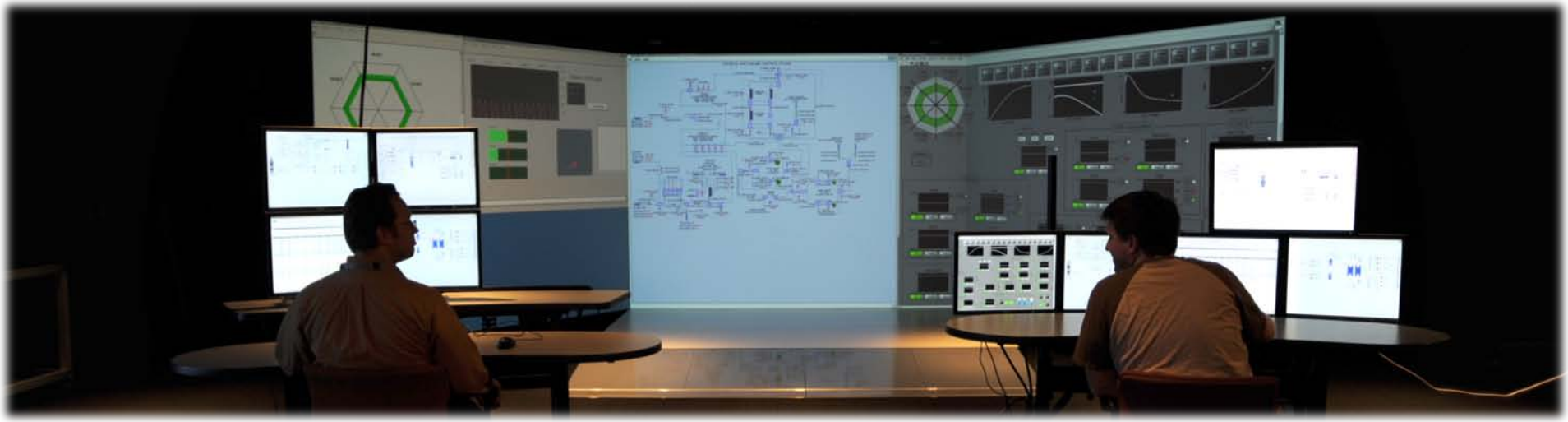
Engaging the nuclear utilities

- Research and development of near-term beneficial technologies while building the digital work environment of the future
- Utilities hosts the technology demonstration and effectiveness assessments
- LWRS provides research & associated technologies, training & implementation, and research reports
- LWRS facilitates industry-wide adoption of new capabilities
- Utilities provide in-kind contribution – time, expenses, plant access, plant expertise, reference documents, and other resources (e.g. simulator)
- The Utility Working Group develops a consensus future vision for digital transformation, prioritizes the developments, and provides a peer review of the project results

Utility Working Group

Highly-Integrated Control Room

- End-State Vision for Modernized Control Room
- Human System Interfaces
- Computer-Based Procedures
- Advanced Alarm Systems
- Operator Support Systems
- Advanced Plant Control Automation



Human Performance Improvement for NPP Field Workers

- Targets plant status control, safety tags, and field work processes
- Uses hand-held and hands-free (heads-up) devices to access automated work processes and plant information, using wireless communications
- Uses real-time video streaming and data updates for monitoring, collaboration, and concurrence from remote parties

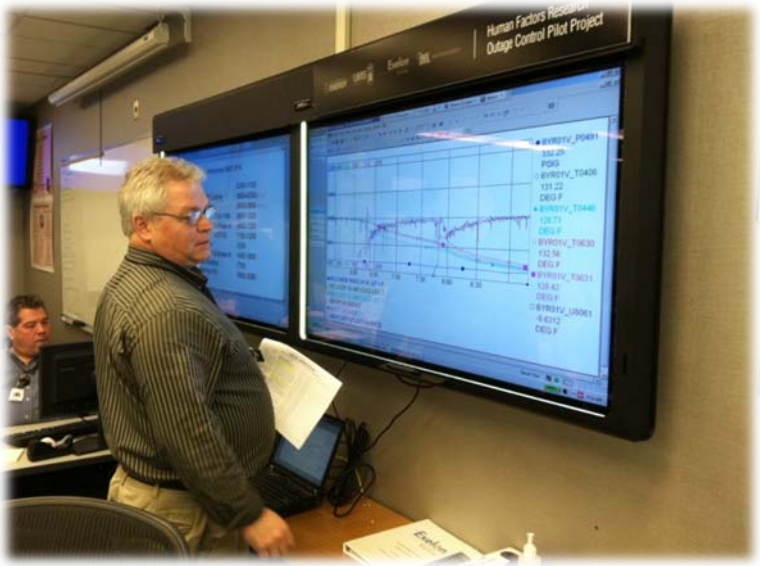
On-Going Developments in Work Efficiency and Human Performance Improvement

- Real-time Work Status
- Emergent Issue Resolution
- Computer-Based Procedures
- Automated Work Packages
- Augmented Reality

[Halden Reactor Project Technologies]

Outage Safety and Efficiency

- Real-time collaboration between outage and plant control centers
- Coordination of urgent outage issues and threats
- On-screen markup of outage plans as they are developed



Operations and Maintenance Task Management

- Mobile technologies for plant workers
- Real-time status to control centers and managers – on any device
- Human error prevention
- Automatic document generation
- Automatic data base updates

Going Forward…..

Develop a seamless digital environment of advanced sensors, instrumentation, control systems and process digital technologies

Enable real-time information exchange among II&C systems, work processes, and plant workers

Transform the NPP operating model to enable long-term sustainability and significant performance improvement

ANS Topical Meeting on Nuclear Plant Instrumentation, Control, and Human-Machine Interface Technologies – July 2012

Probabilistic Safety Assessment and Management (PSAM) 2013 Topical Conference on Fukushima